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Note

Influencing factors of recurrence of chronic sinusitis after nasal endoscopic surgery

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In nasal endoscopic surgery, recurrence of chronic rhinosinusitis is not uncommon which may be due to the trauma and injury viz. bone exposure, fibrous scarring, and ostia stenosis caused by surgical procedure. Here, we have investigated the various factors that contribute to such recurrence. Eligibility assessment was conducted on all patients with chronic rhinosinusitis admitted to our hospital between January 2020 and April 2023, resulting in the recruitment of 200 patients scheduled for nasal endoscopic surgery. After a minimum of 12 months postoperative follow-up, patients included in the final analysis were categorized into recurrence and non-recurrence groups. Through multifactorial logistic regression analysis, smoking, VAS score, pterygoid sinus (S) score, sinus-oral sinus complex (OMC) nasal polyps, allergic rhinitis, deviated septum, and postoperative infection were identified as independent influencing factors for postoperative recurrence (P <0.05). Thus, the factors influencing recurrence after nasal endoscopic surgery in patients with chronic sinusitis comprise smoking, VAS score, lesion extent (AE, S, OMC score), nasal polyps, allergic rhinitis, deviated septum, and postoperative infection. The study concludes that implementing effective clinical interventions targeting these factors is crucial for reducing recurrence rates in patients.

Keywords: Chronic rhinosinusitis, Sinus, Smoking

Chronic rhinosinusitis (CRS) is characterized by chronic inflammation of the paranasal sinuses and its pathogenesis is still poorly understood, which hinders the development of new therapeutic strategies[1,2]. According to relevant epidemiological statistics, its global prevalence is about 10%.Clinical management of CRS aims to alleviate the patient's symptoms and is usually multimodal, such as nasal endoscopic surgery plus pharmacological treatment[3]. Surgical treatment with nasal endoscopy is common, with over 400,000 sinus surgeries performed annually in the United States alone[4].

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Though the overall efficacy and safety of nasal endoscopic surgery are currently reliable and mostly clinically certified, the incidence of postoperative recurrence remains high due to the complex pathogenesis of CRS[5,6]. In a comprehensive analysis of a single institutional cohort, short-term polyp recurrence was observed in approximately 50% of patients within 12 months after nasal endoscopic surgery. Patients with refractory diseases suffer from reduced quality of life, poor sleep quality, fatigue, and acute exacerbation of chronic sinusitis, severely compromising prognosis[7,8]. Despite the potential benefits of combined therapy of surgery and medication, postoperative relapse of nasal polyps is possible[9]. In other respiratory diseases such as asthma and allergic diseases, the tracking of the birth cohort of the population from an early age contributes to the identification of influencing factors for disease progression. However, there is no "birth cohort" for chronic sinusitis, and hence analysis of risk factors for postoperative recurrence facilitates the identification of high-risk groups and allows for early preventive measures[10,11]. For example, previous related studies suggest that aspirin-aggravated disease and co-morbid asthma are associated with an increased risk of polyp recurrence. In this context, here, we investigated the influencing factors for the recurrence of chronic sinusitis after nasal endoscopic surgery among the patients who had undergone the same.

Materials and Methods

Participants

All patients with chronic rhinosinusitis admitted to Pu'er People's hospital between January 2020 and April 2023 were assessed for eligibility, and 200 patients were recruited and were scheduled for nasal endoscopic surgery. The eligibility of patient was decided based on at least two out of four cardinal symptoms (i.e., facial pain/pressure, hyposmia/ anosmia, nasal drainage, and nasal obstruction) for at least 12 consecutive weeks, in addition to objective evidence. Objective evidence of chronic rhinosinusitis may be obtained on physical examination (anterior rhinoscopy, endoscopy) or radiography, preferably from sinus computed tomography[12]. All patients included in the final analysis were evaluated for efficacy after at least 12 months postoperatively and

were divided into recurrence and non-recurrence groups. Logistic analysis was performed to determine the risk factors for postoperative recurrence. This retrospective study was approved by the Ethics Committee of our hospital vide number: TH2023019902.

Inclusion and exclusion criteria

Inclusion criteria

(i) with complete case data; (ii) with symptoms, nasal endoscopy and imaging findings conforming to the diagnostic criteria for chronic rhinosinusitis[13]; (iii) without immune system disorders; and (iv) with successful nasal endoscopic surgery and no previous history of nasal endoscopic surgery.

Exclusion criteria

(i) with other nasal lesions; (ii) without contact within 18 months during follow-up; (iii) with non-surgical factors such as systemic factors or irregular follow-up leading to recurrence; and (iv) with other significant organ-related diseases.

Treatment methods

All participants underwent nasal endoscopic surgery with a routine preoperative examination, and the surgical approach was determined intraoperatively by the physician. Postoperative treatment consisted of daily 240 ml nasal saline rinses and medication if necessary. Data on the survey items were collected and recorded by chart review, outpatient follow-up, and telephone follow-up, and then all records were checked to eliminate missing values and illogical case data. The follow-up was performed one year after the surgery and the patients were grouped according to the presence or absence of recurrence.

Assessment criteria

(i) No recurrence: the disease was completely controlled or partially controlled; Postoperative recurrence: there was no significant improvement in symptoms, no significant decrease in Lund-McKay score on CT, no significant difference in the changes of the scores, and evidence of recurrence of polyposis such as congested and edematous sinus mucosa with mucus and pus secretions, polyp formation or hyperplasia, extensive adhesions, atresia or sinus stenosis under nasal endoscopy was observed.

(ii) The severity of the disease was assessed using the visual analogue scale (VAS) score with 0-3 grading as mild, 3-7 as moderate, and 7-10 as severe, and a score higher than 5 indicated that the patient's quality of life was compromised.

Table 1 — Lund-Mackay assessment criteria

	Scores	Grading
Sinus	0	No abnormalities
	1	Partially turbid
	2	Totally turbid
Sinus orifice nasal tract complex	0	No obstruction
	2	Blockage

(iii) The Lund-Mackay score was used to assess the extent of lesions based on sinus CT scans, with parameters including maxillary sinus (M) score, anterior group septal sinus (AE) score, posterior group septal sinus (PE) score, pterygoid sinus (S) score, frontal sinus (F) score, sinus-oral sinus complex (OMC) score, and total sinus score [14]. The assessment criteria are shown in Table 1.

Statistical analysis

SPSS26.0 software was used for data analyses. The measurement data were expressed as (mean ± standard deviation) and tested by an independent sample t-test. The count data were expressed as number of cases (%) and tested using the chi-square test. Logistic analysis was used to analyze the risk factors of postoperative recurrence. A value of $P < 0.05$ was used for a cut-off of statistical significance.

Results and Discussion

Postoperative recurrence

Follow-up was performed 1 year after surgery, and of the 200 participants, 119 patients with no recurrence were included in the non-recurrence group and 81 patients with recurrence were assigned to the recurrence group.

Patient characteristics

In the recurrence group, patients were 30-60 (40.15±11.12) years old, 61 males and 20 females, with BMI of 18-25 (22.51±0.48) kg/m^2, duration of disease of 0.3-19 (5.28±0.69) years, 41 cases with a history of smoking, VAS score of (7.56±1.85), 17 cases with combined drug therapy, and lesion ranges: M-score of (2.88±0.88), AE score of (3.49±0.66), PE score of (3.11±0.79), S score of (2.21±1.56), F score of (2.88±1.39), OMC score of (3.98±0.44), total sinus score of (18.47±4.35), 69 cases with comorbid nasal polyps, 57 cases with comorbid allergic rhinitis, 73 cases with comorbid deviated nasal septum, and 27 cases with postoperative infection.

In the non-recurrence group, patients were 32-65 (40.38±11.24) years old, 84 males and 35 females, with BMI of 18-25 (22.42±0.37) kg/m^2, duration of disease of 0.3-19 (5.35±0.74) years, 41 cases with a history of smoking, VAS score of (5.03±1.88), 17

cases with combined drug therapy, and lesion ranges: M-score of (1.99±0.67), AE score of (2.05±1.02), PE score of (1.70±0.71), S score of (0.72±0.80), F score of (1.15±1.31), OMC score of (2.25±1.28), total sinus score of (9.77±4.61), 69 cases with comorbid nasal polyps, 57 cases with comorbid allergic rhinitis, 73 cases with comorbid deviated nasal septum, and 27 cases with postoperative infection.

There were no significant differences between the two groups in age, sex, BMI, duration of disease, and combination of medication (P >0.05), while significant differences (P <0.05) were observed in smoking, VAS score, lesion extent, nasal polyps, allergic rhinitis, deviated septum, and postoperative infection. (Table 2)

Table 2 — Baseline patient profiles

	Reference	Non-reference	*t*	*P*
No. of patients	81	119	-	-
Age	30-60 (40.15±11.12)	32-65 (40.38±11.24)	0.143	0.886
Sex				
Male	61 (75.31)	84 (70.59)	-	-
Female	20 (24.69)	35 (29.41)	-	-
BMI	18-25 (22.51±0.48)	18-25 (22.42±0.37)	1.495	0.136
Disease course	0.3-19 (5.28±0.69)	0.3-19 (5.35±0.74)	0.675	0.500
Smoking	41 (50.62)	20 (16.81)	-	-
VAS scores	7.56±1.85	5.03±1.88	9.403	<0.001
Combined medication	17 (20.99)	28(23.53)	-	-
Extent of lesion				
Mscore	2.88±0.88	1.99±0.67	8.110	<0.001
AE score	3.49±0.66	2.05±1.02	11.205	<0.001
PE score	3.11±0.79	1.70±0.71	13.168	<0.001
S score	2.21±1.56	0.72±0.80	8.855	<0.001
F score	2.88±1.39	1.15±1.31	8.943	<0.001
OMC score	3.98±0.44	2.25±1.28	11.695	<0.001
Total sinus score	18.47±4.35	9.77±4.61	13.402	<0.001
Comorbid nasal polyps	69 (85.19)	51 (42.86)	-	-
Comorbid allergic rhinitis	57 (70.37)	12 (10.08)	-	-
Comorbid deviated septum	73 (90.12)	68 (57.14)	-	-
Postoperative infection	27 (33.33)	2 (1.68)	-	-

Logistic regression analysis

Multifactorial logistic regression analysis showed that smoking, VAS score, visual analogue scale (VAS), pterygoid sinus (S) score, sinus-oral sinus complex (OMC) nasal polyps, allergic rhinitis, deviated septum, and postoperative infection were independent influencing factors for postoperative recurrence (P <0.05). (Fig. 1 & Table 3)

Chronic sinusitis is a nonspecific chronic inflammatory disease of the nasal mucosa[15]. Despite benefits from surgery and medications to achieve symptomatic relief, the high risk of recurrence and the complex and diverse internal immune mechanisms impose difficulties in clinical management and compromise the efficacy of surgery and medications. Refractory chronic rhinosinusitis unresponsive to maximal drug and surgical treatment impairs patient prognosis and significantly increases the economic burden on patients[16,17]. Therefore, research on risk factors for recurrence in patients with chronic sinusitis after nasal endoscopic surgery to develop targeted treatment strategies for early implementation of effective targeted interventions is instructive and positive for improving patient prognosis. In a previous single-institution cohort study examining the relationship between surgical scope and polyp recurrence, it was found that more extensive surgery

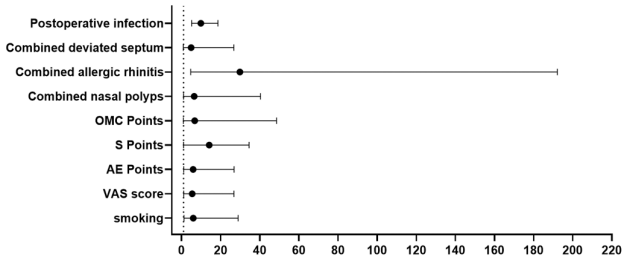

Fig. 1 — Logistic analysis forest plot of postoperative recurrence risk

Table 3 — Logistic regression analysis of the risk of postoperative recurrence

Factors	Regression coefficient	Standard error	*Wald value*	*OR*	*95% CI*		*P*
Smoking	1.779	0.802	4.932	5.974	1.235	28.931	0.012
VAS score	1.685	0.820	4.379	5.455	1.109	26.749	0.031
Extent of lesion							
AE score	1.785	0.899	3.914	5.913	1.104	26.851	0.041
S score	2.635	1.034	6.712	14.109	1.001	34.523	0.009
OMC score	1.889	1.008	3.494	6.688	0.920	48.594	0.048
Comorbid nasal polyps	1.844	0.921	3.996	6.435	1.005	40.353	0.041
Comorbid allergic rhinitis	3.398	0.932	12.753	29.798	4.652	192.111	<0.001
Comorbid deviated nasal septum	1.574	0.855	3.352	4.899	0.905	26.701	0.049
Postoperative infection	2.288	0.394	48.545	9.841	5.125	18.614	0.001

prevented polyp recurrence. It has been reported that septal sinus rhinization is associated with less polyp recurrence compared to "functional" septal sinus resection and that Draf-III frontal sinusotomy is linked to a lower recurrence rate.

The results of this study showed that 40.50% of patients experienced recurrence during the one-year follow-up, which is comparable to or better than other cohort studies that reported a relapse rate of 50-60%. Previous studies assessing ancillary factors associated with recurrence found that the severity of polyposis prior to nasal endoscopy was significantly related to recurrence. Multifactorial logistic regression analysis herein showed that smoking, VAS scores, S score, OMC nasal polyps, allergic rhinitis, deviated septum, and postoperative infection were independent influencing factors for postoperative recurrence. Previous studies have shown that tobacco contains more than 4,000 chemicals, volatile compounds such as benzene, toluene and xylene, and the concentration of benzene and toluene in the blood of smokers is considerably higher than that of non-smokers, and these aromatic substances may exert adverse effects on the nasal mucosa and sinuses. Nasal endoscopic surgery decreases the immune function of the patient. Long-term smoking causes hyperplasia and hypertrophy of mucus glands, a significant increase in cupped cells, excessive mucus secretion, resulting in cilia adhesions, deterioration of inversion function, difficulty in mucus drainage, and secretion of inflammatory factors by lymphocytes, which causes swelling of the nasal mucosa and leads to recurrence and persistence of sinusitis. The VAS score is influenced by disease severity, and mental, emotional and psychological factors and has poor reproducibility. The Lund-Mackay CT scan of the paranasal sinuses objectively can evaluate the severity of the patient's disease. The more severe the disease, the higher the risk of relapse, which was supported by the results of the current study. The results of the literature show that eosinophils may be associated with the recurrence of chronic sinusitis, and the higher the degree of eosinophil infiltration, the higher the risk of recurrence[18,19]. The reason is that eosinophil infiltration of epithelial cells induces the release of inflammatory mediators, triggering an inflammatory response with unsatisfactory therapeutic results and easy recurrence after nasal endoscopic surgery. Eosinophils migrate into the inflamed mucosa by releasing and migrating Th2 cytokines and also exacerbate inflammation through their secreted cytokines such as II-3, IL-5, and granulocyte-macrophage colony-stimulating factor, causing a vicious cycle of disease, prolonging healing, and leading to further recurrence of nasal polyps[20]. In addition, patients with high eosinophil concentrations are predisposed to allergic rhinitis, leading to narrowing of the sinuses, occlusion, and nasal adhesions, which, according to the results of this study, are risk factors for increased postoperative recurrence. Deviated nasal septum is the most common and closely related causative factor in clinical practice, with compensatory enlargement of the contralateral middle turbinate, septal sinus and anterior group of surrounding anatomical structures caused by septal deviation, while rebound hypertrophy after septal correction and ipsilateral inferior turbinate hypertrophy can lead to increased risk of postoperative recurrence in patients due to the release of inhibitory factors[21]. Furthermore, postoperative infection also increases the risk of recurrence of nasal polyps. Since surgical treatment fails to completely eradicate the inflammatory response of the nasal mucosa[22], postoperative infection stimulates inflammatory mediators secreted by mucosal epithelial cells, increased secretions, and nasal mucosal edema, leading to recurrence of nasal polyps. These results suggest that despite the risk of recurrence of chronic rhinosinusitis after endoscopic surgery, postoperative recurrence can be managed with purposeful early interventional behaviours that target the influencing factors for recurrence.

The present study has the following limitations: patients without recurrence were not followed up with sufficient detail compared with patients with recurrence, and patients with recurrence may lose confidence in current medical and surgical treatments that improve quality of life, suggesting a potential selection bias. In addition, further multi-institutional studies of the relationship between surgical scope and postoperative recurrence are required, as no other variables were found to be significantly associated with reduced recurrence under surgeon control.

Conclusion

Influencing factors for recurrence after nasal endoscopic surgery in patients with chronic sinusitis include smoking, VAS score, lesion extent (AE, S, OMC score), nasal polyps, allergic rhinitis, deviated septum, and postoperative infection. Clinical

interventions should be implemented in patients with these factors to effectively reduce recurrence rates.

Conflict of Interest

Authors declare no competing interests.

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